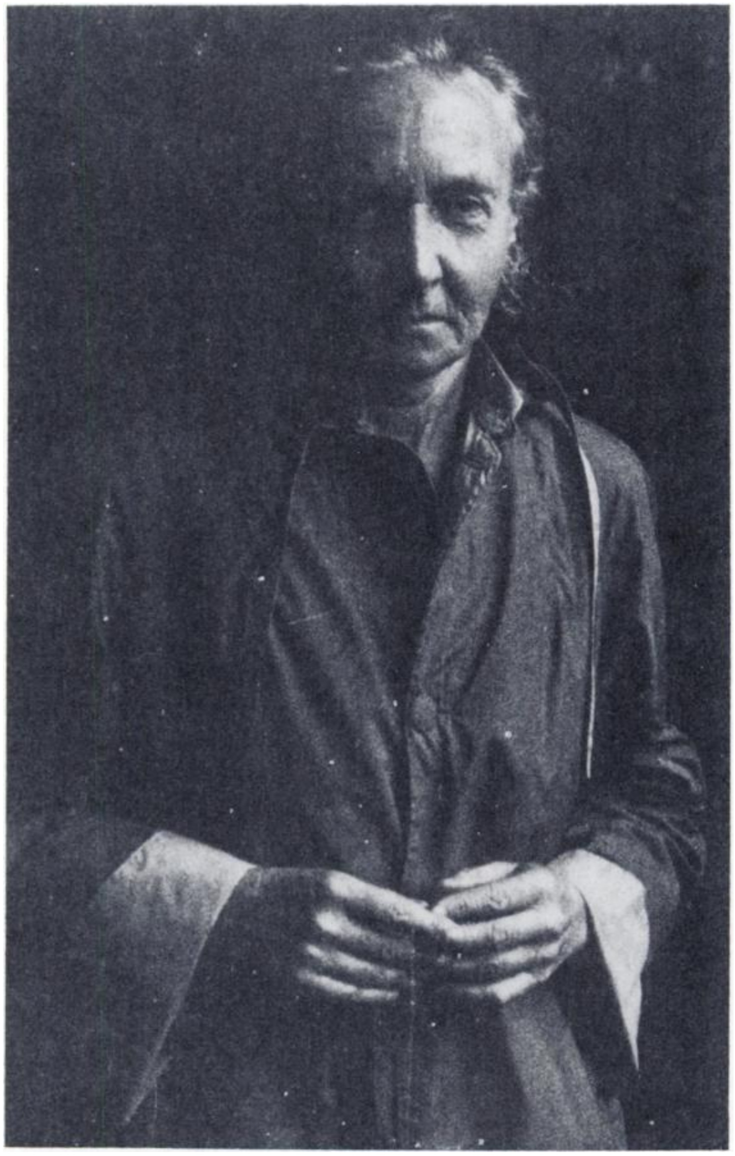

Iréne Curie
1897–1956

This photograph of Iréne Curie was made in 1953 on the occasion of a meeting of The International Commission of Standards of Radioactivity, held in Stockholm, Sweden. It was a rather dark, rainy day, and as she was leaving the conference, Madame Curie donned her raincoat. When asked if she would have her picture taken, she graciously pushed the raincap back and moved to a window for what little light was available. These circumstances helped create this unusually artistic composition for which we are indebted to our Historian, Dr. William Myers, photographer *par excellence.*

In the article reproduced on the opposite page, Iréne Joliot and her husband, Frédéric, reported the transmutation of atoms that produced radioactive daughters. For this discovery they received the Nobel Prize for chemistry in 1935.

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Artificial Production of a New Kind of Radio-Element

By F. JOLIOT and I. CURIE, Institut du Radium, Paris

SOME months ago we discovered that certain light elements emit positrons under the action of α-particles[1]. Our latest experiments have shown a very striking fact: when an aluminium foil is irradiated on a polonium preparation, the emission of positrons does not cease immediately, when the active preparation is removed. The foil remains radioactive and the emission of radiation decays exponentially as for an ordinary radio-element. We observed the same phenomenon with boron and magnesium[2]. The half life period of the activity is 14 min. for boron, 2 min. 30 sec. for magnesium, 3 min. 15 sec. for aluminium.

We have observed no similar effect with hydrogen, lithium, beryllium, carbon, nitrogen, oxygen, fluorine, sodium, silicon, or phosphorus. Perhaps in some cases the life period is too short for easy observation.

The transmutation of beryllium, magnesium, and aluminium α-particles has given birth to new radio-elements emitting positrons. These radio-elements may be regarded as a known nucleus formed in a particular state of excitation; but it is much more probable that they are unknown isotopes which are always unstable.

For example, we propose for boron the following nuclear reaction:

$$_5B^{10} + {}_2He^4 = {}_7N^{13} + {}_0n^1$$

$_7N^{13}$ being the radioactive nucleus that disintegrates with emission of positrons, giving a stable nucleus $_6C^{13}$. In the case of aluminium and magnesium, the radioactive nuclei would be $_{15}P^{30}$ and $_{14}Si^{27}$ respectively.

The positrons of aluminium seem to form a continuous spectrum similar to the β-ray spectrum. The maximum energy is about 3×10^6 e.v. As in the case of the continuous spectrum of β-rays, it will be perhaps necessary to admit the simultaneous emission of a neutrino (or of an antineutrino of Louis de Broglie) in order to satisfy the principle of the conservation of energy and of the conservation of the spin in the transmutation.

The transmutations that give birth to the new radio-elements are produced in the proportion of 10^{-7} or 10^{-6} of the number of α-particles, as for other transmutations. With a strong polonium preparation of 100 millicuries, one gets only about 100,000 atoms of the radioactive elements. Yet it is possible to determine their chemical properties, detecting their radiation with a counter or an ionisation chamber. Of course, the chemical reactions must be completed in a few minutes, before the activity has disappeared.

We have irradiated the compound boron nitride (BN). By heating boron nitride with caustic soda, gaseous ammonia is produced. The activity separates from the boron and is carried away with the ammonia. This agrees very well with the hypothesis that the radioactive nucleus is in this case an isotope of nitrogen.

When irradiated aluminium is dissolved in hydrochloric acid, the activity is carried away with the hydrogen in the gaseous state, and can be collected in a tube. The chemical reaction must be the formation of phosphine (PH_3) or silicon hydride (SiH_4). The precipitation of the activity with zirconium phosphate in acid solution seems to indicate that the radio-element is an isotope of phosphorus.

These experiments give the first chemical proof of artificial transmutation, and also the proof of the capture of the α-particle in these reactions[3].

We propose for the new radio-elements formed by transmutation of boron, magnesium and aluminium, the names *radionitrogen*, *radiosilicon*, *radiophosphorus*.

These elements and similar ones may possibly be formed in different nuclear reactions with other bombarding particles: protons, deutrons, neutrons For example, $_7N^{13}$ could perhaps be formed by the capture of a deutron in $_6C^{12}$, followed by the emission of a neutron.

[1] Irène Curie and F. Joliot, *J. Phys. et. Rad.*, 4, 494; 1933.

[2] Irène Curie and F. Joliot, *C.R.*, 198; 1934.

[3] Irène Curie et F. Joliot, *C.R.*, meeting of Feb. 29, 1934.